Space Weather Technical Forecast

Issued on Thursday, 18 May 2023 at 01:11 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Relatively quiet solar wind. Chance of R1/R2 radio blackouts. Chance of unsettled or active periods of geomagnetism on days 2 and 3.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with only C-class flares observed. The largest was a C9.5 flare, which peaked at 17/2148 UTC originating from the newly numbered sunspot region AR3310 currently rotating around from the southeast limb (source of the M9.6 flare on the 16th May). There are currently six numbered sunspot regions on the visible disc. AR3305 is currently the largest region, although is showing signs of decay and very little activity. However, this region will soon be overtaken by the newly AR3310 as it continues to rotate away from the southeast limb. This region is beginning to show signs of its magnetic complexity and is provisionally classified as a Beta-Gamma/Dai configuration - although it's still difficult to obtain an accurate analysis due to its viewing angle.

A filament lift-off was observed in the northwest quadrant at 17/1827 UTC, although there appears to be no evidence of a CME associated with this feature in current imagery. Meanwhile, type II radio emission associated with a C-flare originating from AR3309 at 17/1530 UTC in the southwest quadrant produced a CME seen in imagery. This is currently undergoing analysis. However currently, no Earth-directed CMEs have been observed in the past 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind speed, as measured by DSCOVR at L1, was Slightly Elevated through the period, on a downward trend from around 460km/s to 420km/s. The Phi angle has been near neutral or positive (away from the Sun). The solar wind density was average at first, falling to below average. The IMF was also at ambient strengths between 5 and 6 nT whilst the Bz remained mainly positive. As a result, geomagnetic activity over the past 24 hours was mainly Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV), as measured at GOES16, became slightly elevated following either the M9.6 flare or large back-sided CME at the same time, but remained well below the active S1/minor storm threshold. High energy electron flux (greater than 2MeV), as measured at GOES16 was at low background levels. The 24-hour integrated fluence has been well below Active levels. At 18/0001UTC, 2.64e6 integrated pfu was recorded.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity will be mainly Low (C-class), but with a chance of isolated Moderate (M-Class) flares, notably down to the newly numbered AR3310 which i currently rotating into view around the southeast limb, which has a history of high M-flares.

Solar Wind / Geomagnetic Activity: Solar winds are expected to be near ambient for the most part, with no CMEs or coronal hole fast winds until the wind from CH03/04 perhaps passes over Earth later on Day 2 (19 May) and into Day 3 (20 May). Geomagnetic activity is expected to be

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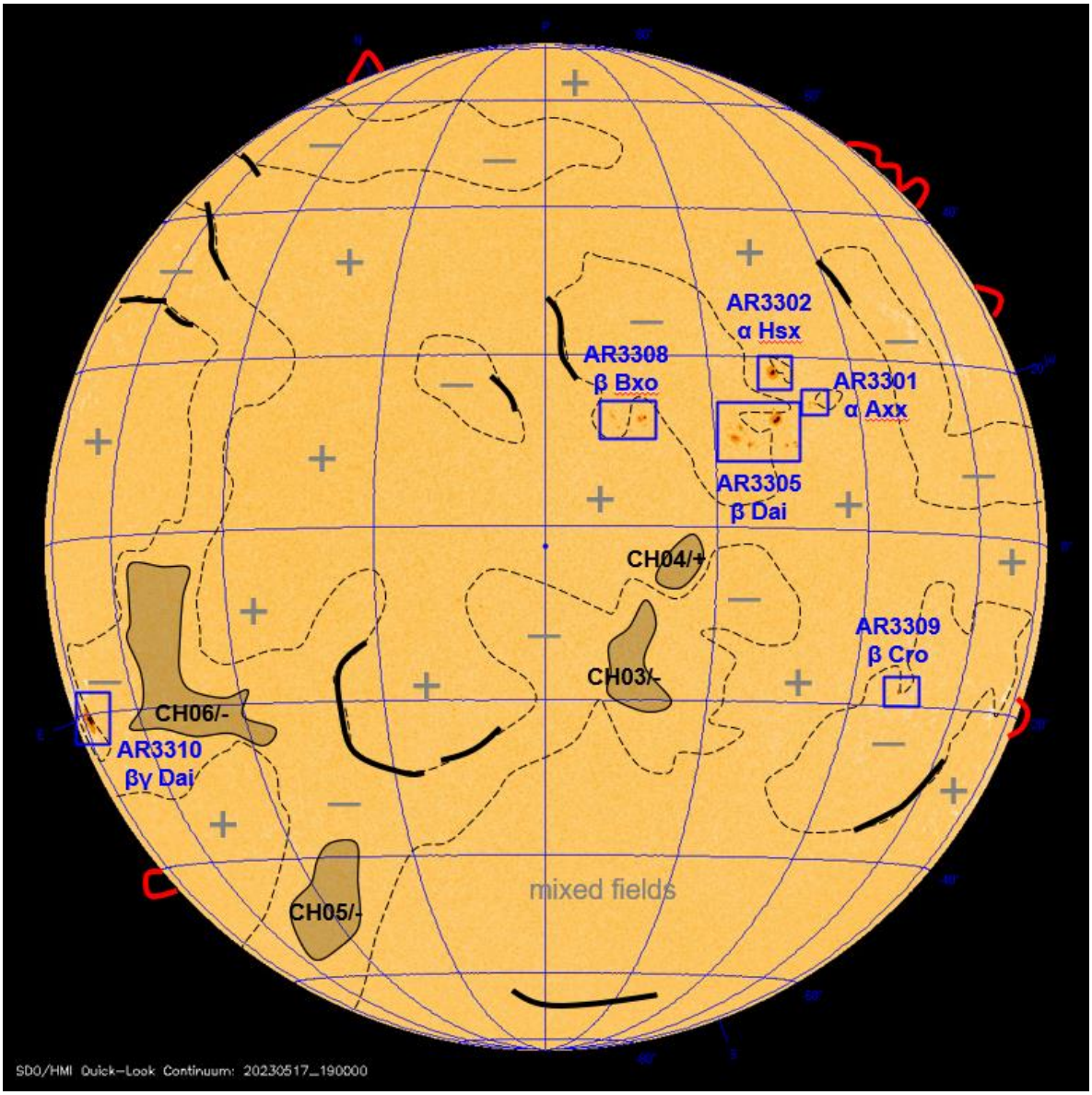
mostly Quiet as a result until then (Kp0-2) with a chance of Unsettled or Active levels (Kp3-4) by days 3 and 4 (19-20 May), with a slight chance (10 %) of an isolated G1/minor storm (Kp 5).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is currently elevated but not expected to breach S1 threshold, therefore assuming no further flares during the 4 day period, it should remain at background tolerances. High energy electron flux (greater than 2MeV) is expected to remain at background levels, as is the associated 24-hour fluence.

Figure 1. Solar Analysis Valid 17/1900 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

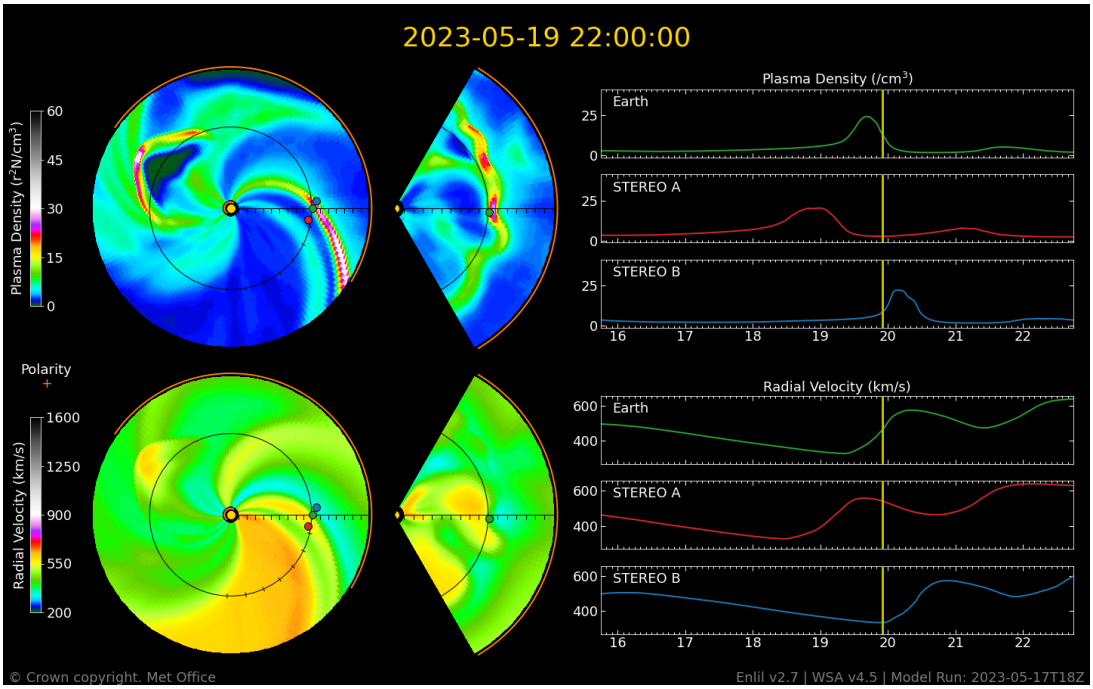
The solar wind is currently at slightly elevated levels, but slowly easing down back to ambient. There are currently no CMEs now expected during the forecast period. There are two small coronal holes centre-disc which could elevate the solar wind again at Earth by Days 2 and 3 (19th-20th), possibly lasting into Day 4 (21st) with a slight chance (10%) of an isolated G1/minor storm, but most likely seeing Unsettled to Active periods (Kp3-4).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	10	10	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: MOSWOC Enlil (top) and Ensemble (below) – shows arrival of fast wind from a couple of CHs near centre disc on the 19-20th May.



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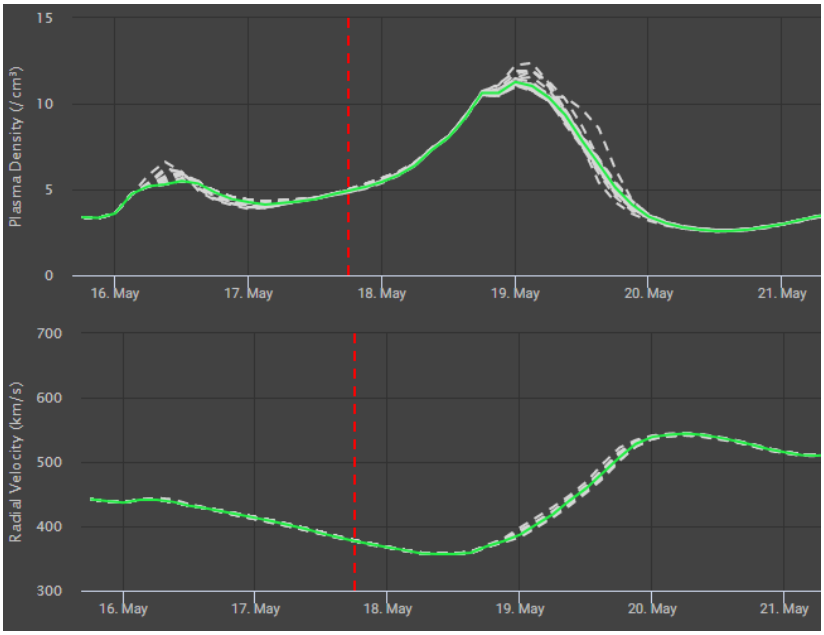

Radio Blackouts - X-Ray Flares:

There are currently six sunspot regions on the visible disc, the majority of which are decaying unipolar or else minor bipolar groups. The two exceptions to this are AR3305 and the newly numbered AR3310 currently rotating around the southeast limb, which was responsible for the M9.6 flare on the 16th May (likely X-class had it been in full-view). AR3305 has yet to produce any significant flare activity, perhaps because for all its increase in size and number of spots it remains fairly neatly a straightforward Mt Wilson Beta group. The statistical probability of M-flares (R1-R2) is around 20% at the moment, but based on the recent history of the new sunspot this has now been increased to 50% chance, with a 10% chance of an isolated X flare.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	50	50	50	50
Very Active	R3 to R5 X Class	No	10	10	10	10

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Figure 3: SDO intensitygram (left) and SDO magnetogram (right) shows AR3310 rotating around the SE limb – some magnetic complexity can be seen, although difficult to get an accurate analysis due to the angle. Source of the M9.6 flare on May 16.

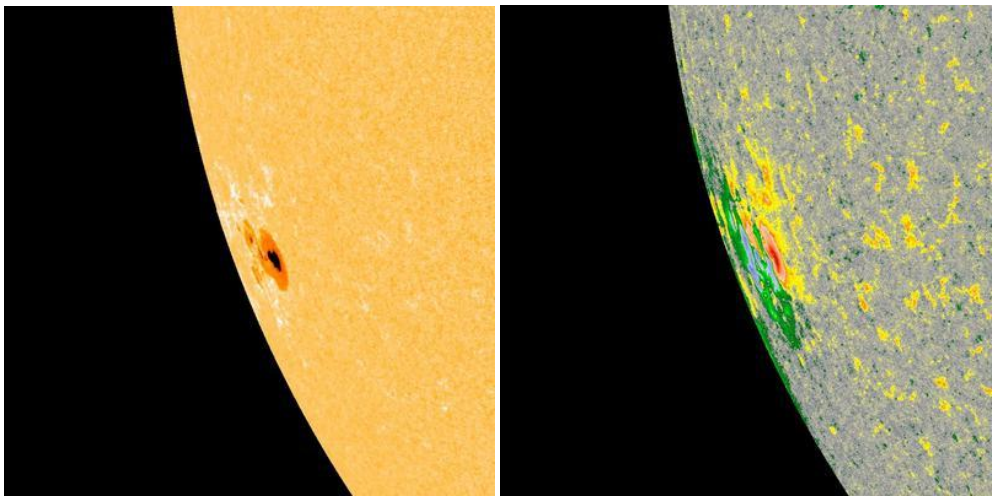
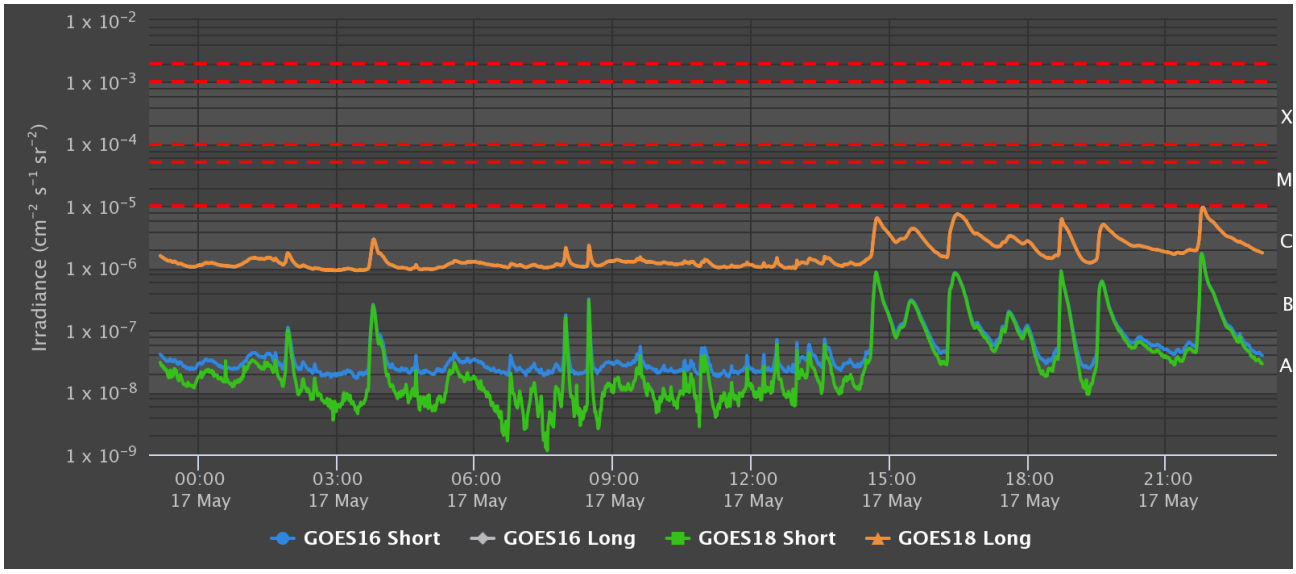


Figure 4: GOES X-Ray flares



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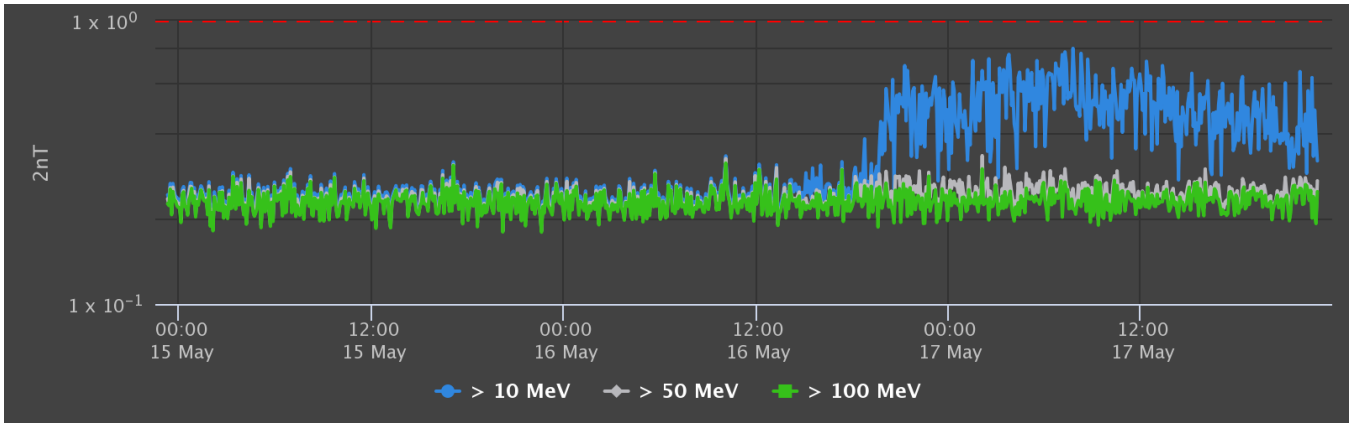
Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux, as observed by GOES16 became slightly elevated yesterday (16 May), either caused by the recent M9.6 flare observed at 16/1643 UTC or from the large back-sided CME which occurred at a similar time. However, the proton flux has remained below the S1/minor threshold, and is currently expected to remain below unless any further large flares occur.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	10	10	10	10
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Figure 5: GOES16 Proton Flux (last 3 days) – shows proton flux has become slightly elevated due to either the M9.6 flare from AR3310 in the SE on May 16th, or from a large far-sided partial halo CME which occurred at a similar time. Remains below the active S1 minor storm threshold.



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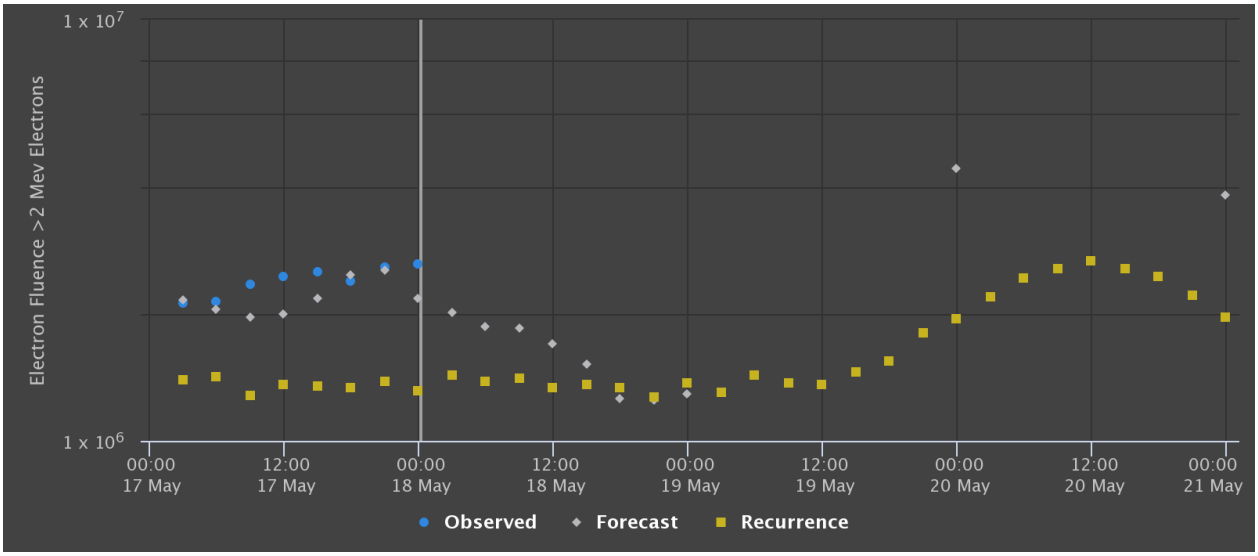
High Energy Electrons Event (≥ 2MeV):
The high energy electron flux (greater than 2MeV) has remained at normal Background levels over the past 24 hours, and this is likely to remain the case through the coming four days in the expected absence of any drivers for increasing counts. Perhaps elevating a little if we get an elevated wind from coronal holes 19th May onwards. The corresponding 24-hour fluence is also expected to remain well below the active threshold.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	2	5	5
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 6: MOSWOC REFM electron fluence – observations and forecast



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